

## Patent Claims:

1. Method for the production of an iron (II) sulphate-containing reducing agent, comprising the concentration of an iron (II) sulphate-containing used sulphuric acid and the separation of the sulphuric acid from the obtained precipitate.
2. Method according to claim 1, characterised in that separation of the concentrated sulphuric acid from the obtained precipitate occurs by means of filtration.
3. Method according to claim 1, characterised in that separation of the concentrated sulphuric acid from the obtained precipitate occurs by means of sedimentation or centrifuging.
4. Method according to one of claims 1 to 3, characterised in that the iron (II) sulphate-containing used sulphuric acid is obtained from the production of titanium dioxide according to the sulphate process.
5. Method according to one of claims 1 to 3, characterised in that the iron (II) sulphate-containing used sulphuric acid is obtained from a metal pickling process.
6. Method according to one of the preceding claims, characterised in that the iron (II) sulphate-containing used sulphuric acid has a titanium content of less than 1.5 % by weight, preferably less than 0.8 % by weight.
7. Method according to one of the preceding claims, characterised in that the separated precipitate contains 40 to 60 % by weight of iron (II) sulphate monohydrate, 3 to 10 % by weight of further metal salts, 15 to 30 % by weight of sulphuric acid and 10 to 13 % by weight of water.

8. Method according to one of the preceding claims, characterised in that the iron (II) sulphate-containing used sulphuric acid is concentrated to a sulphuric acid concentration of more than 50%.
9. Method according to claim 8, characterised in that the iron (II) sulphate-containing used sulphuric acid is concentrated to a sulphuric acid concentration of 60 to 80%.
10. Method according to one of the preceding claims, characterised in that following separation of the sulphuric acid, reduction of the amount of sulphuric acid adhering to the separated precipitate takes place by means of further separation, partial neutralisation or neutralisation.
11. Method according to claim 10, characterised in that reduction of the amount of sulphuric acid adhering to the separated precipitate takes place by washing with water, dilute acid, saturated  $\text{FeSO}_4$  solution or diluted  $\text{FeSO}_4$ -containing aqueous solutions.
12. Method according to claim 11, characterised in that washing is carried out with 40 to 500 % by weight of washing medium, based on the separated precipitate.
13. Method according to one of claims 11 or 12, characterised in that washing is carried out at a temperature of 55 to 100°C.
14. Method according to claim 13, characterised in that washing is carried out at a temperature of 55 to 75°C.
15. Method according to claim 10, characterised in that reduction of the amount of sulphuric acid adhering to

the separated precipitate takes place by displacement with compressed air or by washing with steam.

16. Method according to claim 15, characterised in that washing is carried out at a temperature of greater than 100°C.
17. Method according to claim 16, characterised in that washing is carried out at a temperature of 105 to 130°C.
18. Method according to claim 10, characterised in that reduction of the amount of sulphuric acid adhering to the separated precipitate takes place by reacting the separated precipitate with water and metallic iron or an alkaline iron (II) compound at a temperature of greater than 60°C.
19. Method according to claim 18, characterised in that the reaction takes place at a temperature of 60 to 110°C.
20. Method according to claim 19, characterised in that the reaction takes place at a temperature of 75 to 85°C.
21. Method according to one of claims 18 to 20, characterised in that 80 to 98 mol-% of metallic iron or alkaline iron (II) compounds, such as iron (II) carbonate or iron (II) hydroxide or iron (II) oxide, based on the sulphuric acid contained in the separated precipitate, is reacted, and as much water is added so that the molar ratio of water to iron (II) sulphate is 6.5 to 7.
22. Method according to one of claims 18 to 21, characterised in that metallic iron having an average particle size of 5 mm or less is used.

23. Method according to claim 22, characterised in that metallic iron having an average particle size of 100  $\mu\text{m}$  or less is used.
24. Method according to one of claims 18 to 23, characterised in that the reaction of the separated precipitate with metallic iron or the alkaline iron (II) compound takes place continuously and a non-reacted proportion of iron or alkaline iron compound is removed from the overflow and returned.
25. Method according to claim 24, characterised in that removal of the iron takes place by means of a magnetic separator.
26. Method according to one of claims 18 to 21 and 24, characterised in that the alkaline iron (II) compound is reacted in the form of a natural ore such as siderite.
27. Method according to one of claims 18 to 21 and 24, characterised in that the alkaline iron (II) compound is a component of an industrial by-product.
28. Method according to claim 10, characterised in that reduction of the amount of sulphuric acid adhering to the separated precipitate takes place by means of partial neutralisation or neutralisation by adding powdered alkali compounds, in particular  $\text{CaCO}_3$ ,  $\text{CaO}$ ,  $\text{Ca(OH)}_2$ ,  $\text{MgO}$  and/or  $\text{Mg(OH)}_2$  or elutriations thereof, such as lime water.
29. Method according to one of claims 10 to 27, characterised in that following reduction of the amount of sulphuric acid adhering to the separated precipitate, partial neutralisation or neutralisation of the residual acid in the separated precipitate takes place by adding powdered alkali compounds, in particular  $\text{CaCO}_3$ ,  $\text{CaO}$ ,

$\text{Ca(OH)}_2$ ,  $\text{MgO}$  and/or  $\text{Mg(OH)}_2$  or elutriations thereof, such as lime water.

30. Method according to one of claims 10 to 29, characterised in that following reduction of the amount of sulphuric acid adhering to the separated precipitate or following partial neutralisation or neutralisation of the residual acid in the separated precipitate, a defined amount of water, an aqueous saline solution or a diluted sulphuric acid is added and granulation takes place.
31. Method according to claim 30, characterised in that the amount of water added is 100 to 550 mol-%, preferably 250 to 350 mol-%, based on the iron (II) sulphate monohydrate contained in the separated precipitate.
32. Method according to claim 31, characterised in that the required amount of water comes from the addition of moist green salt.
33. Method according to one of claims 30 to 32, characterised in that granulation and control of the granule size occurs by means of mechanical formation or by blowing with air or by spraying with a nozzle or a rotary disk or by cooling.
34. Iron (II) sulphate-containing reducing agent producible by a method according to one of the preceding claims.
35. Iron (II) sulphate-containing reducing agent according to claim 34, characterised in that it has an average crystallite size of less than 2  $\mu\text{m}$ , preferably between 0.1 and 1.0  $\mu\text{m}$ , and particularly preferred between 0.2 and 0,5  $\mu\text{m}$ .

36. Iron (II) sulphate-containing reducing agent according to one of claims 34 or 35, characterised in that it has a titanium content of 5 to 15 % by weight, based on iron, and/or a manganese content of 1.5 to 4 % by weight, based on iron.
37. Use of an iron (II) sulphate-containing reducing agent according to one of claims 34 to 36 for reducing the soluble chromate content in cement.
38. Use according to claim 37, characterised in that 0.01 to 5.0 % by weight, preferably 0.2 to 1.5 % by weight, of the iron (II) sulphate-containing reducing agent is added to the cement.
39. Use according to one of claims 37 or 38, characterised in that the iron (II) sulphate-containing reducing agent is added to the powdered cement after milling and before or during filling in packages or bulk containers or transport containers.
40. Use according to one of claims 37 to 39, characterised in that after mixing with the powdered cement, the reducing effect of the iron (II) sulphate-containing reducing agent increases at least temporarily as the storage time increases.
41. Use according to one of claims 37 to 40, characterised in that the iron (II) sulphate-containing reducing agent is first added to the cement when it is used, in that the iron (II) sulphate-containing reducing agent is added to the cement during mixing with water or directly before this or directly thereafter.
42. Use according to claim 41, characterised in that the iron (II) sulphate-containing reducing agent is added in the form of a suspension or solution.

43. Use according to one of claims 37 to 42, characterised in that the iron (II) sulphate-containing reducing agent is used together with or in a mixture with green salt.
44. Preparation of cement and water-soluble metal sulphates, characterised in that the preparation contains 0.01 to 5.0 % by weight, preferably 0.2 to 1.5 % by weight, of the iron (II) sulphate-containing reducing agent defined according to one or more of claims 34 to 36.
45. Preparation of cement, water and water-soluble metal sulphates, characterised in that the preparation contains 0.01 to 5.0 % by weight, preferably 0.2 to 1.5 % by weight, of the iron (II) sulphate-containing reducing agent defined according to one or more of claims 34 to 36, based on the cement.